EFFICIENCY OF SPEED HUMP IN REDUCING SPEED WITHIN HIGHER EDUCATIONAL INSTITUTION AREA

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I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

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ABSTRAK

Bonggol jalan adalah salah satu alat menenangkan lalu lintas yang biasa digunakan di Malaysia. Pemasangan alat menenangkan lalu lintas itu telah mewujudkan persekitaran yang lebih selamat didiami dengan peningkatan keselamatan jalan raya berikutan kelajuan yang lebih rendah digunakan. Bonggol jalan telah dilaksanakan secara meluas di Malaysia terutamanya di kawasan perumahan, tetapi keberkesanan bonggol jalan raya dalam mengurangkan kelajuan di kawasan institusi pengajian tinggi tidak diterokai dengan baik. Untuk mengukur keberkesanan jalan raya di kawasan ini, kajian perlu dijalankan untuk menilai kecekapan bonggol jalan dalam mengurangkan kelajuan di Universiti Malaysia Pahang, Kampus Gambang. Kajian ini dijalankan untuk mengukur kecekapan bonggol kelajuan dalam mengurangkan kelajuan di persimpangan empat kaki yang tiada isyarat di Jalan Persekutuan 222 yang terletak di hadapan pintu masuk utama UMP. Pistol radar digunakan untuk mengumpul data kelajuan aliran bebas kereta penumpang dengan dan tanpa adanya bonggol jalan. Pengurangan kelajuan telah dikenalpasti selepas pemasangan dua set tiga bonggol bulat dengan ketinggian 50mm-100mm dan lebar 3.7m-4.0m. Peratusan kadar pengurangan kelajuan adalah 56.5%. Ujian T sampel yang berpasangan dilakukan untuk membandingkan pengurangan kelajuan purata sebelum bonggol dipasang dan selepas bonggol dipasang. Keputusan dari analisis t-ujian menunjukkan perbezaan yang signifikan secara statistik dari segi pengurangan kelajuan purata sebelum dan selepas bonggol bulat dipasang yang membuktikan kecekapan bonggol jalan dalam mengurangkan kelajuan di kawasan institusi pengajian tinggi.

ABSTRACT

Road hump is one of the most commonly used traffic calming devices in Malaysia. The installation of such traffic calming device has created a more live-able environment with improvement on road safety as a result of lower speeds. Road humps has been widely implemented in Malaysia especially in residential area, but the effectiveness of road humps in reducing the speed within higher educational institution area is not well explored. In order to measure the effectiveness road humps within this area, a study must be carried out to evaluate the efficiency of road humps in reducing speed within Universiti Malaysia Pahang, Gambang Campus. This study was carried out at the un-signalized four legged intersection of Federal Road 222 that located in front of UMP main entrance. Radar gun was used to collect the passenger's car free flow speed with and without the existence of road humps. It was found that the speed reduction after the installation of two sets of three round-top humps with height 50mm-100mm and width 3.7m-4.0m both-ways was calculated as 56.5%. Paired sample T-tests were carried out to compare the average speed reductions before humps were installed and after the humps were installed. Result from t-test analysis shows a statistically significant difference in terms of average speed reductions before and after the round-top humps were installed that prove the efficiency of road humps in reducing speed within higher educational institution area.

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LIST OF SYMBOLS

SBPWM	Simple Boost Pulse Width Modulation
ZSI	Z source inverter

LIST OF ABBREVIATIONS

UMP	Universiti Malaysia Pahang
MNCS	Multinational Corporations
ECE	East Coast Expressway
LPT	Lebuhraya Pantai Timur
JKR	Jabatan Kerja Raya
MHA	Malaysian Highway Authority
MEC	Malaysia Electric Corporation
FR2	Federal Road 2
FR3	Federal Road 3
SSD	Stopping Sight Distance
OSD	Overtaking Sight Distance
SPSS	Statistical Package for Social Science
MS	Microsoft

CHAPTER 1

INTRODUCTION

1.1 Introduction

Speed humps are parabolic vertical traffic calming devices, a gradual raised area in the pavement surface extending across the entire travel width which intended to reduce the traffic speeds on low volume and low speed roads. Typical speed hump measurement for round-top hump will be 50mm-100mm in height with a travel length of 3.7m-4.0m, according to Malaysia Road Hump Specifications (Bachok et al. 2016). This device will create a gentle vehicle rocking motion which results in most vehicles reduces the speed to 35 km/h. Speed hump shall be accompanied by a traffic calming strategies such as pavement markings and warning signage on the approaches as mentioned by Gonzalo-Orden et al, (2016) so that drivers are notified of their presence. This device work best when they are designed and spaced appropriately. To achieve greater speed reductions, space of speed humps need to be designed closely together. The main purpose of installing speed hump is to introduce discomfort, through shocks and vibrations as stated by Patel and Vasudevan (2016), to driver and passengers, while their vehicle passes over it with the speed greater than the designed speed (Bachok et al. 2016). By installing humps, it will give distraction to the drivers thus it reduces overall speeds of the vehicles (Yaacob and Hamsa 2013).

Speed is the scalar quantity that is the magnitude of the velocity vector. It illustrates acceleration or a high rate of motion on how fast an object is in mobile. A higher speed means an object is moving faster while lower speed means it is moving slower. The object may have been going faster or slower at different points during the time interval. It has zero speed when object is stationary. Speed is an important factor in road safety affecting both collision occurrence and extremity (Jateikiene et al. 2016). As mentioned by Ahmed et al, (2015) to achieved zero collision count, it is almost

impossible but through a proper study, reduction in the severity of accident can be achieve. As drivers move faster, they have limited time to respond to road conditions and might resulting collision that will cause more harm. Annually, millions of road users are killed or wounded in traffic collisions. In developing countries, death tolls are projected to increase by over 80% and by 65% in the developed countries by 2020. Traffic collisions in Malaysia have been inclining at an average rate of 9.01% per annum from 1974 to 2010. In 2020, Malaysia is estimated to have over 20 death tolls per 100,000 people. Imprudent speed is considered to be the major contributory factor to road accidents, injuries and deaths (Ghadiri et al. 2013).

National Speed Limits is a set of speed limits applicable on Malaysia expressways, federal roads, state roads and municipal roads. Failing to obey the speed limit on Malaysian roads and expressways is an offence as subject to Malaysian Road Safety Act 1987 which can be fined up to RM300, depending on the difference between the speed limit and the driven speed. According to National Speed Limits of Malaysia, for institutional areas, the speed limit of 35 km/hr is applicable during rush hours.

This study was conducted to inspect the level of efficiency of speed humps as a traffic control device in reducing speed within higher institutional areas as there was no previous study of humps in assisting drivers to reduce the speed of the vehicle within this area was conducted

1.2 Background of Study

Universiti Malaysia Pahang (UMP) was established by the Government of Malaysia on February 16, 2002. UMP was set up as a competency based technical university which specialises in the fields of engineering and technology. UMP is located on the east coast state of Pahang, the biggest state in Peninsular Malaysia with vast areas of rainforest endowed with a wide range of bio diversities and natural resources. The campus is also strategically located in the East Coast Industrial Belt Peninsular Malaysia which hosts a large number of multinational corporations (MNCS) in the chemical, petrochemical, manufacturing, automotive and biotechnology industries. UMP offers a wide range of skills-based tertiary education programmes and hands-on-based tertiary education in engineering and technology to produce competent engineers.

For the road network outside of UMP Gambang campus, there are two classification of road. First, East Coast Expressway (ECE/LPT) (E8) which are designed under JKR R6 standard with maximum speed limit of 120 km/h and minimum lane width of 3.5 m. This expressway has full access control and being managed under the administration of Malaysian Highway Authority (MHA) that connects Karak to Kuala Nerus. Second, Federal Road (Federal Route 222) with JKR R5 standard, is a road that connecting between Gambang traffic light and Gambang toll exit. The design speed limit is 100 km/h and lane width is 3.5 m. This road is dual carriageway that has partial access control. This highway overlaps with Federal Route 3 from Kuantan Airport Interchange to Jalan Pekan Exit. The intersection in front of UMP is connecting Gambang toll plaza and signalized intersection at FR2, which is also known as Jalan Gambang and Jalan Tanah Putih, is a major highway in Kuantan that connects Gambang to Kuantan and FR3, which links the town of Bukit Ibam and Bandar Muadzam Shah to the town of Bandar Baru Rompin. The Kilometre Zero of the Federal Route 63 starts at Bukit Ibam and ends at its intersection with the FR3, the main trunk road of the east coast of Peninsular Malaysia.

GEOMETRIC DESIGN ITEMS				ROAD CATEGORY																							
Design Control & Criteria	1	Design Standard	n/a	R6			R5			R4			R3			R2			R1			R1A					
	2	Access Control	n/a	Full			Partial			Partial			Partial			None			None			None					
	3	Terrain Condition	n/a	F	R	M	F	R	M	F	R	M	F	R	M	F	R	M	F	R	M	F	R	M			
	4	Design Speed	km/h	120	100	80	100	80	60	90	70	60	70	60	50	60	50	40	40	30	20	40	30	20			
Cross Section Elements	5	Lane Width	m	3.65			3.50			3.25			3.00			2.75			(5.00)			(4.50)					
	6	Shoulder Width	m	3.00	3.00	2.50	3.00	3.00	2.50	3.00	3.00	2.00	2.50	2.50	2.00	2.00	2.00	1.50	1.50	1.50	1.50	1.50	1.50	1.50			
	7	Shoulder Width (Structures) > 100 m	m	1.00			1.00			1.00			0.50			0.50			0.50			0.50					
	8	Median Width (Minimum)	m	6.00	5.00	4.00	4.00	3.50	3.00	3.00	2.50	2.00	n/a			n/a			n/a			n/a					
	9	Median Width (Desirable)	m	18.00	12.50	8.00	12.00	9.00	6.00	9.00	6.50	4.00	n/a			n/a			n/a			n/a					
	10	Marginal Strip (Width)	m	0.50			0.50			0.25			0.25			0.00			0.00			0.00					
	11	Minimum Reserve Width	m	60.00			60 (50)			40(30)			20.00			20.00			12.00			12.00					
Elements of Design	12	Stopping Sight Distance	m	285	205	140	205	140	85	180	120	85	120	85	65	85	65	45	45	30	20	45	30	20			
	13	Passing Sight Distance	m	n/a			700	550	450	675	500	450	500	450	350	450	350	300	300	250	200	300	250	200			
	14	Minimum Radius	m	570	375	230	375	230	125	300	175	125	175	125	85	125	85	50	50	30	15	50	30	15			
	15	Minimum Length of Spiral	m	n/a			n/a			n/a			n/a			n/a			n/a			n/a					
	16	Maximum Superelevation	Ratio	0.1			0.1			0.1			0.1			0.1			0.1			0.1					
	17	Maximum Grade (Desirable)	%	2	3	4	3	4	5	4	5	6	5	6	7	6	7	8	7	8	9	10					
	18	Maximum Grade	%	5	6	7	6	7	8	7	8	9	8	9	10	9	10	12	10	12	15	25					
	19	Crest Vertical Curve (K-crest)	n/a	120	60	30	60	30	15	45	22	15	22	15	10	15	10	10	10	5	5	10	5	5			
	20	Sag Vertical Curve (K-sag)	n/a	60	40	28	40	28	15	35	20	15	20	15	12	15	12	10	10	8	8	10	8	8			

Figure 1-1 Geometric Design for Rural Standards

Based on the figure shown, the rural standard of road design has been classified into three different classes which are design control and criteria, cross section elements and elements of design. In each class, there are few sub units. In cross section elements for JKR R5, the sub units are minimum median width is 4m with desirable median

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